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FORMAL DISCIPLINE.

By W. H. Metzler.

I think the student of history would find few, if any, exceptions to the rule that what vitally touches everyday life and has existed for long years has considerable truth underlying it. New things will come in and give new light and show up old things in their true light, but they are not likely to entirely upset beliefs of long standing.

The belief in formal discipline has existed for a long time and it passed unchallenged until Herbart and his followers denied its right, though protests had been made earlier by Rousseau, Pestalozzi and others. The logical conclusion from this doctrine—that discipline obtained from the study of one subject was largely if not wholly useful in the study of another—was thought to be that a person should be almost equally good in everything and especially in those subjects most alike. It being patent to all that people are not equally good in everything the conclusion followed that the doctrine was wrong. At first the discussion was all from the deductive side, but of late experiments have added much to establish a true theory.

While the older defenders claimed too much, it seems equally true that some, at least, of the opponents denied too much. The swing from the one position to the other went too far, but the pendulum is undoubtedly settling down and finding its true amplitude.

The theory of formal discipline, or perhaps as it might better be called, general discipline in its older form seems to have been based upon a conception of the mind as an aggregate or a collection of faculties any one of which when disciplined by the study of one subject could use the strength thus gained in the study of any other. There seems now to be good reason for considering the functions of the mind as interrelated and interdependent. We cannot attend to different things equally well at the same time.

This problem of formal discipline has been taken up recently with renewed vigor both from the deductive and inductive sides.

Some experiments have been made which, according to the authors, showed that the mind has no general functions or transferable powers, but that all is specific. It is, however, quite certain that they did not take into consideration all the facts involved, and hence were mistaken in their conclusions. It is unfortunate that some men fresh with the enthusiasm of a new idea, or with too great a zeal to overthrow an old one, have drawn hasty conclusions from ill-conceived and poorly digested experiments. A writer recently made the following statement: "As there is no exact correspondence between mathematical and life situations, a good mathematician may be a poor reasoner in nonmathematical situations in life, and a good reasoner in such situations may be a poor reasoner in mathematics. These statements are not opinions but experimentally demonstrated facts." * While there may be no exact correspondence between mathematical and life situations there is, however, a correspondence and if properly taught there is no reason why those proficient in mathematics should not be able to handle problems of life better on account of their mathematical training.

The experiments themselves would seem to require little attention if such sweeping statements had not been made with regard to them. The first experiment consists in giving to high school students the following two sets of questions:

In Geometrical Reasoning.

1. Prove that the bisectors of the interior angles of a trapezoid form a quadrilateral, two of whose angles are right angles.
2. The bisector of the exterior angle at the vertex of an isosceles triangle is parallel to the base of the triangle.
3. If the bisectors of the equal angles of an isosceles triangle meet the opposite sides in D and E, prove DE parallel to the base of the triangle.

In Practical Reasoning.

1. Give all the reasons you can why a high school education is a good thing.
2. Why should the town rather than the parents pay for the education of its children?

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* Cf. Lewis, *School Review*, April, 1905. Horne, *Education*, May, 1909.

3. Which is of more value, physical or mental training? Give all the reasons you can for the position you take.

The results of this test showed, of course, that those who answered the questions in geometry well did not answer the others best. In my judgment the test was valueless for the following reasons:

1. The test in geometry was too narrow, depending upon too few principles, which those who answered well might have memorized.

2. To reason about anything we must know the data on which the reasoning is based, but students of high school age would not as a general thing know the data of such educational questions and therefore could not reason about them. Their answers would be largely what they had heard others say.

3. Both tests depend too much on chance information and not on reasoning.

The second test was to take those college students who were good in mathematics and see if they were good in certain law courses which require a good deal of reasoning. Here again the ability to reason depends upon their knowledge of the facts and there was nothing to show these were the same for all.

Other experiments such as those of Coover and Angell * on sense-discrimination, of Ebert and Meumann,† of Wench,‡ and of Fracker § on memory are quite conclusive in showing that there is a general gain in the case of the trained over the untrained in going from one subject to another.

The expermients of Ebert and Meumann show that there was not only a gain in going from one subject to another but that the gain was greatest in material that was most closely related to that practised upon. The gain was not only in quickness but in retentiveness and it persisted, as after a considerable lapse of time there was no loss in training but in some cases there was an actual increase in memory capacity.

The experiments of Roediger || show that neatness made conscious as an aim or ideal in one subject will cause the student to be neat in other subjects.

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* *Am. Jour. Psy.*, 1907.

† *Arch. f. d. gesam. Psy.*, Vol. IV., 1905.

‡ *British Jour. Psy.*, Vol. II.

§ *Univ. of Iowa Studies in Psy.*, June, 1908.

|| *Ed. Review*, November, 1908.

Urbantschish found that sound stimulus increased the sensitivity of the subject for visual, gustatory, olfactory, and tactile stimuli. Epstine found that sound stimulus increased the visual stimuli. Vogt showed that habituation to distraction in one situation could be carried over to other fields.*

Observation shows that logical or rational memory grows with use and it would seem that this gain was to a considerable extent due to the improvements of associating ideas and, as it were, tying them up together. The more ideas we have the more points of attachment for new material so that learning carries with it an increased capacity for learning other things related to it. Besides there is a gain in habits of learning. A great gain to be derived from any study is the learning of good methods of work—to learn what the tools are and how to use them. This has a general or transferable phase as well as a particular phase. Problems in arithmetic that seemed hard in school appear quite easy in later life though the individual may not have thought of them in the meantime and may not have been studying closely related subjects during the interval.

Some experiments would seem to show that there was a transfer of reciprocal interference as well as a transfer of improvement and that a person may become immune to improvement by practise. This last is probably due to habits becoming fixed and less elastic after long training.

It seems therefore fairly well agreed now that there is a transfer of discipline from one subject to another and the only question is the extent of the transfer and how it takes place. It is thought by some that this transfer of gain was due to "identical elements" in the subjects. The elements may be identical as to substance, as to method, or as to aim.

The conscientious effortful pursuit of any study results in rendering the mind more efficient in other lines of study. There is no development without conscious purposeful effort. Where there is little effort there is little development. In connection with the question as to whether one subject is better than another for developing these powers it should be noted that perhaps no subject in itself teaches anything but is the means or occasion for bringing out the lessons. It would seem, however, that those subjects which in their study require most effort to acquire any particular power were best suited for developing that power.

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* Cf. Stephen S. Colvin, "Some Facts in Partial Justification of the So-Called Dogma of Formal Discipline," *University of Illinois Bulletin.*

A very important gain from any study properly pursued is an insight into the methods and technique of thinking. Another gain is the creation of ideals such as accuracy, neatness, system, etc.

Every experience has in it the possibility of generalization, but its value depends upon the way it is worked out by the individual. Another gain, therefore, in the proper study of a subject is the habit of making generalizations. Pupils should be taught to look all around a subject and see its bearings, but this cannot be done by a narrow teacher. On the other hand a narrow teacher can do much to prevent a student from getting much general through special discipline, and from transferring his training and culture from one subject to another. Pupils should become interested seekers after truth and not dogmatists.

Thinking has its origin in some perplexity or doubt, then past experience or knowledge comes in to offer suggestions as to a solution. These suggestions must be critically examined and judgment suspended during further inquiry. Good thinking then, involves a fund of experiences, facts, and principles from which suggestions proceed, a fertility of suggestion, and an appropriateness and consistency in what is suggested. A large experience is not so necessary as a trained experience. It is not information that makes a man educated, but rather well grounded attitudes and habits of discriminating tested beliefs from mere assertions and opinions. Professor Dewey says "The only information which, otherwise than by accident, can be put to logical use is that acquired in the course of thinking." *

With some people suggestions come readily while with others they come slowly and we call them bright or dull accordingly. There is also a difference in the number or range of the suggestions, but the best mental habits require a proper balance between too many and too few. Again suggestions may vary as to their quality. Slowness of suggestion is not always to be deplored. Better slowness with depth than readiness with shallowness. Finally suggestions must be appropriate and the mind held to an orderly course. The serious vocations of adults

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* Dewey, "How We Think," p. 53.

tend to make them orderly in their thinking, but modes of activity must be found to accomplish this same object for the student.

In all reflection there is a double movement, first from the original facts or data to the suggested conclusion—the inductive movement, and then from this general conclusion back to the particular facts—the deductive movement. The inductive movement is towards the discovery of a general principle and the deductive towards its testing. Each process throws light upon the other and students should not be allowed to make an induction, *i. e.*, draw an inference without following it up deductively to see if they understand it. He must be able to apply his general principles to particular cases and to new situations. The deductive phase is quite as important as the inductive. The two should be combined to produce critical thinking. " Only deduction brings out and emphasizes consecutive relationships, and only when relationships are held in view does learning become more than a miscellaneous scrap-bag." *

These are the rudiments of mental discipline and it is the business of education to supply the conditions for their cultivation. The aptitude of acquiring them varies with the individual but they are not natural endowments. We are endowed with power of thought, which education does not create but trains to think well.

There is of course danger in separating logical thought too much from every day affairs so that students cannot apply it, just as there is danger of making some studies too mechanical as reading sometimes is, or of making others merely informational as geography sometimes is.

Because in the training of some people logical thought has been made too much an abstract thing in itself and they have not been able to apply it to practical affairs it has been thought by a few that the study of those subjects which are most abstract tend to produce this condition. Such fault lies with the teaching and study of the subject and not with the subject itself.

There is another danger which consists in putting too much stress on the product and too little on the process of attaining the result. A student may easily come to think that the answer is the all important thing. The methods of the teacher may be responsible for this, for method covers not only what we consciously employ for the purpose of mental training, but what is done without conscious effort which reacts upon the activity and mental attitude of the pupil. There is too much testing by observable results and by these alone. Too few questions are asked and answers read with a view of getting at mental habits and powers. Because mathematics lends itself more readily than other subjects to the exact measurement of results, it is quite possible that we as teachers may look too much to the results of the information acquired and too little to the results of the processes and habits developed. We ask A and B to prove the same proposition in geometry giving them 100 and 75 respectively for their answers, but are we at all sure that these numbers measure their relative knowledge of the proposition? Perhaps in any particular case we cannot do better but we can keep more constantly in mind the possibility of error such markings may contain.

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* Dewey, *ibid.*, p. 97.

It is thought by some that things must have an interest in themselves to be of value and we are asked to pay more attention to utilitarian and practical aims and to replace the more abstract subjects of the curriculum by those of greater interest. Before doing this, however, it might be well to pause long enough to ask what is meant by practical and utilitarian subjects and whether the interest demanded is the mere entertainment type or something more lasting. As Professor Dewey well says it is " not the thing done but the quality of mind that goes into the doing that settles what is utilitarian and what is unconstrained and educative." * He also says: " Truly practical men give their minds free play about a subject without asking too closely at every point for the advantage to be gained; exclusive preoccupation with matters of use and application so narrows the horizon as in the long run to defeat itself. It does not pay to tether one's thoughts to the post of use with too short a rope. Power of action requires some largeness and imaginativeness of vision. Men must at least have enough interest in thinking for the sake of thinking to escape the limits of routine and custom. Interest in knowledge for the sake of knowledge,

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* Dewey, *ibid.*, p. 167.

in thinking for the sake of the free play of thought, is necessary then to the emancipation of practical life—to make it rich and progressive."*

Interest is a good thing where and in so far as it is possible, but some things are not in themselves interesting and any interest in them must be acquired. There must be effort to attend to or to concentrate on some things and a large part of the discipline derived consists in that attitude of mind which tolerates unpleasant and distracting things. Spencer defined the educated being as one who did what he ought when he ought whether he wanted to or not.

Some teachers succeed in arousing interest and enthusiasm, in communicating information, and in developing energy, but fail in developing habits of attending to details that makes certain mastery over means of execution, which is power. Other teachers succeed in developing skill, facility and mastery of technique, but fail in developing power of discrimination, a sense for ideas, and enlarged mental vision.

To study mathematics for its applications is to aim at quantity rather than at quality. The better grade of students will get some discipline in connection with the facts but the majority will fail to get those unique results in training and culture which the study should supply. The ideals of accuracy and truth will be lacking. They will not realize that that which is but partially true is of no value in human experience and will not appreciate the ideal of truth—self sufficient truth—for truth's sake. Truth is one of the greatest passions of the human race, it is fundamental and should never be denied the possibility and opportunity of exercising its uplifting influence towards the ideal. There is so much in the world that tends to keep us down on the lower plains of life that we as educators should cherish the opportunity and means that will not only give us higher ideals but which will draw us up with a fixed purpose to live nearer to them.

Another thing of which we as teachers must be careful is our attitude towards problems of conduct, because the way they are met has an influence which extends to every other mental attitude. If we are not in the habit of giving serious inquiry and reflection to vital questions of conduct it is not at all likely our habits of thought will have much influence in less important matters.

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* Dewey, *ibid.*, p. 139.

To secure this general training it seems fairly well established that we must observe the following general rules:

1. Make the activity, such as neatness, etc., which we wish to transfer, an object of thought. The habit and its general significance and bearing must be understood by those who are to acquire it.
2. General attitudes of feeling and will should be cultivated through specific training. Respect for authority, etc., are qualities readily transferable.
3. The general art of learning should be acquired through specific study. How to work with the highest effectiveness, with the greatest economy of effort and time is an accomplishment too seldom attained, and one which receives too little attention.
4. Such habits as observation should be cultivated in as wide a field as possible.*

The great business of the schools is to teach pupils how to think well, to have proper ideals and methods and to have a will sufficiently developed to make them do what they ought.

We have seen that the most important thing that a student should obtain from the study of a subject is not information but mental power, proper ideals and ambitions, and these are for the most part transferable from one subject to another. Our duty then as teachers of mathematics is plainly to ascertain just what may be expected from the study of each of our subjects and aim to accomplish that. What each subject is good for is a study in itself and has been treated elsewhere.

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* Cf. Stephen S. Colvin, "Some Facts in Partial Justification of the So-Called Dogma of Formal Discipline," *University of Illinois Bulletin.*